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(19)

(54) GAMING MACHINE

(71) I, ARTHUR SHAW, a British Subject, of 99—101 Broomfield Road, Earlsdon, Coventry, Warwickshire, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to gaming machines of the kind in which a rotatable chance reel is used to determine a 'win' condition of the machine. Such gaming machines having a plurality of individually rotatable chance reels are usually known as fruit machines, as the peripheries of the wheels are divided into circumferentially adjacent positions bearing markings indicating different fruits or other symbols and which are registrable with a viewing aperture when the reels have stopped. Hitherto known gaming machines of the fruit machine kind have employed an electrical or mechanical drive to rotate the reels from rest. This drive is usually disconnected or rendered inoperative to allow the reels to spin freely for a timed period determined by some form of timing mechanism, which triggers a braking mechanism to bring the reels to rest in a position in which a symbol on the periphery of the reel is in line with a viewing aperture. Certain combinations of symbols aligned in the viewing aperture for a series of adjacent reels are designated 'wins,' for example a line of three symbols of the same kind. A disadvantage of such known mechanisms is that the drive and braking mechanisms are complicated, with the associated risk of breakdowns and consequent high servicing costs.

According to the present invention, a gaming machine of the kind including a rotatable chance reel also includes drive means incorporating a stepping motor operable to move the rotatable chance reel through a series of incrementally-spaced positions and automatically to hold the chance reel securely in any one of said positions when the drive is rendered inoperative.

In a practical arrangement such a stepping motor could be driven by pulses derived from a pulse generator. In order to introduce randomness, the pulse generator desirably produces substantially uniform pulses at randomly-variable frequency or alternatively, the pulse frequency can be held constant whilst the duration of operation of the generator is varied by using some form of random timer. As a further alternative both a random timer and random pulse generator may be employed. In practice, the pulse frequency may be varied in a controlled manner, for example increased slowly to build up the motor and reel speed gradually in order to prevent the motor falling out of synchronism with the pulses owing to, say, the motor being partially stalled. The pulse frequency and thus the motor and reel speed may then be either gradually reduced from the normal operating level to rest or stopped suddenly.

The use of pulses enables the instantaneous position of the reel to be determined by counting the pulses produced and thus the steps of the motor made in any given time period. In order to determine the position of a reel in any one complete revolution a reference point is afforded to one position of the reel. This is conveniently achieved by arranging a switch device in this position which is triggered by some form of operating arm mounted at one position on the reel. For example a "Hall-effect" type of semiconductor switch device could be employed in which a semiconductor switch element is operable to produce a small output voltage when subjected to the field of a magnet positioned nearby. A shield is mounted at one position on the reel and is movable into position between the magnet and the semiconductor switch element to shield the magnetic field therefrom and thus cause a change in the voltage signal produced. Alternative switch devices, in particular photo-electric devices, reed switches or other microswitches could be employed.

When a counter is employed to count the

number of pulses produced, and thus the number of incremental movements made by the reel, in any given time period, the switch device is used to reset the counter when a complete revolution has been made and thus the instantaneous count represents the incremental position of the reel in any one revolution.

Desirably, control means are provided to control the direction of rotation of the stepping motor and associated reel. The control means may also be operable to produce a predetermined movement or sequence of movements of the stepping motor and reel in either direction.

Thus it will be appreciated that the use of a stepping motor drive enables a separate braking circuit to be dispensed with and also provides a facility for knowing the instantaneous position of a reel.

There now follows a description of a particular embodiment of the invention, by way of example only, with reference to the accompanying drawing, which shows a block schematic layout of a stepping motor drive for a rotatable chance reel of a gaming machine of the fruit machine kind.

Referring to the drawing, a normal play of the machine is made by operating a switch 22 to start a timer 24 which signals, along a control line 36, a pulse generator 5 to produce a stream of pulses for a time period, which may be predetermined or random, as discussed later. The pulses from the pulse generator 5 are fed along output line 7 to a phasing or commutating unit 6 which ensures that the pulses are correctly phased and thence along lines 8 to a stepping motor 1 arranged to drive a reel 4. From practical considerations, in order to avoid the expense of using a high power stepping motor, a reduction gear box 2 is connected to the motor output shaft to produce increased torque for the drive to the reel 4 which is mounted on the output shaft 3 of the gear box 2. In order to compensate for the change in revolution rate from the motor output shaft to the reel, the pulses produced by the pulse generator 5 are also fed along line 9 to a frequency divider unit 10 which effectively divides by a factor corresponding to the gear box reduction factor, in this example ten-to-one, and thus produces one output pulse for every ten input pulses. Thus, each output pulse corresponds to an increment of movement of the reel 4, which is in turn equivalent to ten increments of movement of the motor output shaft in view of the ten-to-one step down ratio of the reduction gear box 2. The output of the frequency divider 10 is fed along line 11 to a two stage counter including a first stage 13 for counting up to ten and a second stage 14 for counting in tens. These counters 13 and 14 may conveniently take the form of shift registers or decade counters and are provided with a series of output lines 16, one output line corresponding to each digit. Thus for a count of, say, nine an output signal is present on the corresponding 'ninth' output line. This output, or indeed outputs from any other output line or lines (in the case of a two-digit count), may be used to trip a pay-out circuit (not shown) which typically would dispense the number of coins related to the value of a 'win'. Thus each possible angular 'rest' position of the reel 4 is allocated a separate output line or combination of lines 16. In order to maintain this relationship a switch arrangement is provided for resetting the counters 13 and 14 to zero once a predetermined reference point on the reel 4 reaches a predetermined fixed position. In this case a "Hall-effect" switch is employed, including a semiconductor switch device 19 operable under the influence of a magnetic field of a magnet 17 to produce an output signal, which is fed along the line 20 to reset lines 15 for the counters 13 and 14. A shield 18 is fitted at one position on the reel 4 so that it can pass between the magnet 17 and the semiconductor switch unit 19 to shield the latter from any magnetic influence of the former and thereby produce a change in the output signal along the line 20. This change is arranged to reset the counters 13 and 14 to zero and thus one position of the reel 4 constitutes a 'zero' or reference position for the counters 13 and 14 and the next successive positions (together constituting one complete revolution of the reel 4) are registered by successive counts on the counters 13 and 14. In this particular example, the reel 4 has twenty positions although other numbers may be employed, for example twenty five. Thus the counters 13 and 14 are allowed to run to a total count of 20 before being automatically reset by the magnetically-operable semiconductor switch arrangement. The illustration of the latter is diagrammatic and other orientations of the various component parts may be employed.

In order to ensure that the reel 4 stops with a symbol fully in the viewing aperture, that is ten pulses from the pulse generator 5 have been produced since the previous symbol was fully displayed in the viewing aperture, it is necessary that, if the random timer 24 stops before this count of 10 is completed, the pulse generator 5 will continue to produce pulses to complete the count and will then stop. This is achieved by a feedback circuit comprising a line 26, controlled by a normally-open switch 27, between the frequency divider 10 and the pulse generator 5. When the timer 24 stops switch 27 is arranged to close to connect the pulse generator to the output of the

frequency divider 10 through line 26. A signal on line 26 is arranged to stop the pulse generator 5, but will only be present when a pulse is produced by the frequency divider 10 after 10 pulses from the pulse generator 5 have been received since the previous output from the frequency divider 10. The latter can be regarded as being reset ready for the next count of 10 after it produces an output pulse; but is also provided with a separate reset facility described later.

As a safeguard against the reel positions and pulses falling out of synchronism for example due to the reel 4 being moved manually and left, say, between positions at which symbols are fully displayed in the viewing aperture, it is necessary that the reel 4 makes one complete revolution to reset the counters 13 and 14 and the frequency divider 10 so that the instantaneous count on the counters 13 and 14 represents the true position of the reel 4 and in particular the symbol displayed in the viewing aperture, with reference to the zero or reference setting at which semiconductor switch 19 is operated. Thus for each 'normal' play of the machine the reel 4 makes at least one complete revolution, equivalent to 200 pulses from the pulse generator 5, for a twenty symbol-position reel, and a typical 'normal' play would be 1¾ reel revolutions. This synchronism is achieved by a line 29, controlled by a normally-closed switch 28, between the frequency divider 10 and the reset lines 15 to the counters 13 and 14. When the reel 4 passes its reference position semiconductor switch 19 is operated, as previously described, and a signal is passed to the counters 13 and 14 along reset lines 15 and to the frequency divider 10 along line 29. Thus the counters 13 and 14 and the frequency divider 10 are reset to zero.

The switches 27 and 28 may be of the mechanical, electromechanical or electronic gate type and are operated by the timer 24. It is arranged that switch 28 opens before switch 27 closes, that is just before the reel 4 stops, to prevent the frequency divider 10 from being reset at the zero or reference position, as the player might otherwise be deprived of a win.

In a practical machine several reels would be employed, typically three, each with their own stepping motor drive. In order to introduce randomness, the pulse generator 5 may be a random pulse generator that is producing pulses of generally similar form, but at random frequency, or alternatively the pulse generator 5 may produce uniform pulses at a uniform frequency, but a random timer may be employed to gate the pulses to the stepping motors. As a further alternative both a random timer and random pulse generator may be employed. In practice the pulse frequency may be varied in a controlled manner, for example increased slowly in order to build up the motor and reel speed gradually in order to prevent the motor falling out of synchronism with the pulses owing to, say, being partially stalled. The pulse frequency and thus motor and reel speed may then be either gradually reduced from the normal operating speed to rest or stopped suddenly.

Notwithstanding the randomness of their movement the instantaneous positions of each reel are continuously registered. For 'win' conditions which require the reels to come to rest in a certain relative position, in order to produce a predetermined combination of symbols on the periphery of the reels in a viewing window, a comparator circuit, not shown, but conveniently using logic circuits, such as NAND and AND gates, is employed to compare the rest positions of the reels in order to determine whether or not a 'win' condition is present and, if so, to produce an output signal for actuating an appropriate pay-out. For example, if a count of three for the first reel, a count of five for the second reel and a count of seven for the third reel were required to produce a win, the appropriate output tappings from the respective counters for the reels would be coupled to a three input NAND gate, which would change its output sense only when at each of its inputs an appropriate change in signal level occured. The three, five and seven positions referred to could, for example, correspond to three identical symbols being present in a viewing aperture.

An advantage of the use of the stepping motor drive is that, as an additional playing facility, the reels can be moved independently and incrementally by a separate control shown in this example as a push-button switch 21, without the need for a separate braking mechanism such as a solenoid lock which would be required with a conventional mechanical or electric motor drive. The switch 21 operates to move or 'nudge' a particular one or more reels through a predetermined number of positions and is used in order to, say, complete a win condition partly produced by a preceding normal play of the machine using switch 22, or alternatively to produce another win condition altogether. The direction of the 'nudge' will depend upon the forward/reverse reel action, described later. If required, the 'nudge' facility can be inhibited until after a normal play of the machine in which case a 'nudge' circuit 23 operated by switch 21 is automatically inhibited by a signal applied to an inhibit line 34 from the timer 24 and is reset to an active condition by means of a signal applied to a reset line 25. The reset line 25 also prevents two successive 'nudges' although it

can be arranged that a 'nudge' play may be held over for one or more normal plays. The circuit 23 essentially slows down the pulse rate of the pulse generator 5, by applying a signal on a line 35, to produce a slower rate of reel movement than in a normal play of the machine. In order to nudge the reel 4 through one position, switch 27 is closed momentarily to allow the pulse generator 5 to run until 10 pulses have been produced whereupon an output pulse appears from the frequency divider along line 26 which stops the pulse generator 5. If a two or more position 'nudge' is required then a divider circuit could be used in line 26 to count an appropriate number of pulses from the frequency divider 10 before stopping the pulse generator 5. A random timer could also be used to produce a random'nudge.'

It is readily possible to reverse the direction of rotation of the reels by means of a switch 31 which can be set prior to each normal or additional 'play' of the machine. The counters 13 and 14 are reversible count types, that is with an add or subtract facility. When switch 31 is operated a line 30 to the phasing circuit 6 and lines 32 and 33 to the counters 13 and 14 respectively are energised so as to reverse both the direction of rotation and the pulse count.

As a further optional feature of the machine, one or more reels may be arranged to perform a rocking motion by moving alternately in the forward and reverse directions by a predetermined amount, for example equivalent to six reel symbols, upon operation of a switch (not shown); the rocking motion continuing for a random time period. Switch 31 can be used and can be of the mechanical, electromechanical or electronic gate type. As with the 'nudge' facility, separate switches could be used to control the movement of different reels.

The gaming odds are adjusted accordingly by re-arranging the symbols on the reels to take into account the possibility of moving a single reel incrementally backwards or forwards, in either the 'nudge' or 'rocking' modes, in order to complete a 'win' combination in a viewing aperture. It is further envisaged that the viewing aperture be sufficiently large as to allow two or more adjacent lines of symbols to be viewed simultaneously. In the case of, say, an aperture arranged for viewing three lines of symbols in an array one above the other, diagonal, horizontal and vertical lines of symbols from all (say three) reels may be taken into account for determining possible 'win' conditions.

WHAT I CLAIM IS:—

1. A gaming machine of the kind including a rotatable chance reel, the gaming machine also including drive means incorporating a stepping motor operable to move the rotatable chance reel through a series of incrementally-spaced positions and automatically to hold the chance reel securely in any one of said positions when the drive is rendered inoperative.

2. A gaming machine, as claimed in Claim 1, in which the drive means also includes a pulse generator arranged to produce electrical pulses to drive the stepping motor through a random number of said positions.

3. A gaming machine, as claimed in Claim 2, wherein the pulse generator is arranged to produce substantially uniform pulses at randomly-variable frequency.

4. A gaming machine, as claimed in Claim 2 or Claim 3, wherein the pulse generator is arranged to produce uniform pulses at a uniform frequency and a timer is provided to control the time period for which the pulses are applied to the stepping motor.

5. A gaming machine, as claimed in any of Claims 2 to 4, in which the drive means also includes means for gradually varying the frequency of pulses produced by the pulse generator.

6. A gaming machine, as claimed in any of the preceding claims, in which the drive means also includes a counter to count the number of pulses produced, and thus the number of incremental movements made by the reel, in a given time period, and a switch device to reset the counter when a complete revolution has been made, whereby the instantaneous count on the counter represents the incremental position of the reel in any one revolution.

7. A gaming machine, as claimed in Claim 6, wherein said switch device comprises a semiconductor switch element operable by a magnetic field.

8. A gaming machine, as claimed in any of the preceding claims, in which the drive means includes control means for controlling the direction of rotation of the stepping motor and its associated reel.

9. A gaming machine, as claimed in Claim 8 wherein said control means is operable to produce a predetermined movement or sequence of movements of the stepping motor and the associated reel in either direction.

10. A gaming machine, as claimed in any preceding claim, having a plurality of rotatable chance reels and the same number of drive means, a drive means being associated with each chance reel.

11. A gaming machine, as claimed in Claim 10, including comparator means for comparing the count registered by a counter associated with each reel and representing the reel position at the end of a play of the machine with a corresponding predeter-

mined count representing a win condition for the machine.

12. A gaming machine as claimed in claim 1, the drive means being substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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1471866 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*